Market News

GaAs epi-wafer market to grow at 35%

The bulk semi-insulating GaAs wafer market in 1998 was US$124m (US$15/sq. in): 89% merchant, led by Litton Airtron and FCM; 11% captive, including M/A-COM, SEI and Hitachi Cable.

The epi market was:

• MOCVD: 11% captive, 89% merchant;
60% Japan, 33% N. America, 3% Europe, 4% Rest of World.

• MBE: 49% captive, 51% merchant;
62% N. America, 26% Japan, 2% Europe, and 10% RoW.

Over 1998-2003, epi markets will grow at a compound average annual growth rate of 35%:

• MOCVD from 1.09m sq. inches in 1998 to 1.679m in 1999, 2.409m in 2000, 3.246m in 2001, 4.226m in 2002, and 5.437m in 2003 (with almost all growth merchant);

• MBE from 1.112m sq. inches in 1998 to 1.666m in 1999, 2.338m in 2000, 3.094m in 2001, 3.965m in 2002, and 5.035m in 2003.

Strategy Analytics
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Company News

Philips' new microwave GaAs company

GaAs manufacturer Philips Microwave Limeil (Limeil-Brevannes, Paris, France) has been formed into new wholly-owned Philips company, "OMMIC", to enable "enhanced flexibility...in expanding further in specialised applications, primarily with high-frequency devices and systems for the telecoms market".

This includes foundry-produced MMICs and MOCVD-manufactured devices such as pHEMT low-noise amplifiers for high-end wireless and fibre-optic infrastructures (with 15 years' experience and 40 current customers), and foundry and epitaxy services.

OMMIC also inherits more than 100 patents in GaAs production technologies and processes, as well as the work in developing the "world's first planetary epi reactor" (licensed to AIXTRON). Expansion will involve acquiring additional reactors.

OMMIC
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Endgate and TRW Milliwave form Endwave

TRW Milliwave Inc and Endgate Corp (Sunnyvale, CA, USA), a provider of "first-mile" broadband engines for powering electronic-business gateways, are to merge 50:50 to create Endwave Corp (Sunnyvale, CA, USA) to supply broadband access equipment, including specialised antennae, transceivers and Outdoor Units (ODUs). The current customer base includes Nokia and Hughes Network Systems.

According to Timothy W. Hannemann, TRW executive vice president and general manager of the Space & Electronics Group, TRW's GaAs transceiver MMICs complement Endgate's transceivers, antennas and ODUs for high-speed, wireless telecommunications links.

TRW Inc
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Briefs...Briefs...

"Millimeter Wave Technology Market: A Technical/Economic Analysis", published February 2000 by **Business Communications Co Inc** (US$3350, Tel: +1-203-853- 4266), covers 30-300 GHz devices, e.g. for broadband wireless access (BWA), local multipoint distribution service (LMDS) and automobile collision detection/avoidance.

Briefs...Briefs...

RF IC company **Stanford Microdevices Inc** (Sunnyvale, CA, USA), which last year discontinued contract manufacturing in favour of IC design (shipping its first SiGe and InGaP ICs in Q4), has filed for an initial public offering of US$50m of common stock.

Vitesse Semiconductor Corp (Camarillo, CA, USA) has acquired (for US$450m) fabless company Orologic, whose system-on-chip ICs support OC-48 and OC-192 fibre-optic data rates. In March Vitesse introduced ICs for a complete 10 Gb/s line card for OC-192/STM-64 SONET/SDH transmission (including the VSC7990 laser driver).

• Vitesse has recognised Hong Kong-based IC package design, assembly and test foundry ASAT as a "Vendor of the Year".

Briefs...Briefs...

Northrop Grumman Corp's Electronic Sensors and Systems Sector (ES^3) has been awarded a 24-month, US$3.5m US Navy contract to develop a high-power 540 kW radar transmitter that uses silicon carbide transistors.

IC Insights forecasts that mobile-phone handset shipments are expected to grow 38% to 356m in 2000.

Microsemi acquires Infinesse's HBT group

Microsemi Corp (Santa Ana, CA, USA) has completed the acquisition of Infinesse Corp's HBT Business Products Group (Los Angeles, CA, USA).

Microsemi gains RF and HBT expertise in III-Vs (primarily in GaAs and InGaP) and SiGe for cellular, PCS and 3G, BlueTooth and 5.7 GHz LAN applications. (In March '99, Alpha Industries formed an alliance to develop and manufacture GaAs HBT ICs with Infinesse and Network Device Inc.)

The acquisition is part of an expansion into the wireless, broadband coms and analogue and mixed-signal ICs, following acquisition of the RF Products Group of SGS Thompson, LinFinity Microelectronics Inc and Narda Microwave Semiconductor, and the establishment of the San Diego Design Center specialising in ultra-low-power ASICs for battery-powered applications.

Microsemi has also expanded its optical sensor line with products for a high-density alternative to galvanic isolation transformers, including photodiodes, opto couplers, and photovoltaic MOSFET array drivers. Applications include high-speed, high-density circuits, where high-voltage isolation is necessary (up to 2500 V), e.g. Implantable Cardio Defibrillator firing circuits, Strobe Flash Circuits for Digital Cameras, and automatic aperture control systems. Photovoltaic arrays offer much higher output current than pulse transformers or high-voltage ICs with half the input-to-output (rise-to-fall) time.

Marketing manager Manuel Lynch says that Infinesse's HBT Business expertise in processing InGaAs and InGaAsP should enable development of faster and higher-sensitivity photodiodes and photodetectors for optical networking equipment for DWDM and satellite communications.

Microsemi
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Market News

Alpha's wireless and cable ICs

Alpha Industries Inc (Woburn, MA, USA) has entered into multiple supply agreements with its second-largest customer and is now shipping record numbers of GaAs RF IC switches and discretes to a major European manufacturer of wireless telephone handsets. "It has opened up new opportunities with this customer's newest handsets incorporating data and Internet access."

Alpha is also shipping production volumes of GaAs amplifiers (operating at 28 GHz) for Local Multipoint Distribution System equipment provided by Newbridge Networks for broadband data transmission up to 150 Mbps.

"We are now seeing orders and shipments for our GaAs ICs into a broad range of high-speed wireless and cable data access equipment", says Colin Sweeney, Director of Application Specific Products for Alpha's Wireless Semiconductor segment.

Alpha Industries
Tel: +1-617-935-5150

Briefs...Briefs...

RF Micro Devices Inc (Greensboro, NC, USA) GaAs HBTs has received the following orders:

- **RF2132 power amplifiers for Ericsson's first CDMA cellphone handset (the A1228c).**
- **First orders of PAs for Motorola's iDEN handsets - the high-power, high-efficiency RF2138 PA for extended battery life and longer talk times - plus the RF2361 and RF2442 low noise amplifiers. (The iDEN i2000 digital world phone operates on GSM networks in Europe, the Middle East, Africa, Asia Pacific and iDEN networks. The Internet-capable i1000plus handset combines cellular and two-way radio.)**

Celeritek PA orders

Celeritek Inc (Santa Clara, CA, USA) has received over US$8.5m in follow-on orders for GaAs power amplifiers (to ship this year) from a major US handset manufacturer, for three design-ins across subscriber platforms.

This has been fuelled by growth in CDMA subscribers to almost 50m by end-99 (driven by data applications).

Further capacity investments are being augmented with US$27m raised in a private placement.

Celeritek
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Conexant expands HBT capacity five fold

Conexant Systems Inc (Newport Beach, CA, USA) has completed a US$80m five-fold capacity expansion of its GaAs fab in Newbury Park, CA, USA (from 15,000 4" wafer starts per year a year ago to 75,000). This is in support of its two fastest-growing divisions, wireless communications and network access. A further increase to 95,000 is planned by end-2000 (upgrade of installed equipment to 6" wafers could boost this to 210,000 4" equivalent wspy).

Conexant has also signed a multi-year foundry-partner agreement with Advanced Wireless Semiconductor Co that guarantees an extra 30% capacity (30,000 GaAs HBT wafer starts a year), giving 125,000 in total by end-2000. ASWC's new 57,000 ft^2 facility is in Tainan Science-based Industrial Park, south Taiwan.

Conexant
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Anadigics ships multi-band PAs to Ericsson

Anadigics Inc (Warren, NJ, USA) has shipped production volumes of multi-band GaAs power amplifiers for Ericsson's T18d dual-band wireless phones (its first mobile to feature digital data/fax capabilities and full graphic display).

This is Ericsson's third T-class platform to use Anadigics' multi-band technology, which enables operation in DAMPS 900 MHz and TDMA 1900 MHz bands using one PA and which, according to Barak Maoz, Vice President of Wireless Power Amplifier Products, "optimises board space utilisation while extending talk time."

• Anadigics has promoted John van Saders to Vice President of Advanced Development to "expand product offerings for the wireless and broadband communications markets by discovering new market areas".

Anadigics Inc
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Fax: +1-908-668-5068

Briefs...Briefs...

RFMD product launches:

• RF2162 high-power, high-efficiency linear amplifier for the final RF amp in dual-mode 3V 800-960MHz wireless;

• RF2364 front-end low noise amplifier (operating at 3V) with a high dynamic range for CDMA, TDMA PCS and W-CDMA/cdma2000.

Device News

E/D-mode GaAs FETs take half current of SiGe for mobiles

To meet increasingly stringent linearity and single supply voltage (2.7V) requirements of 2G and 3G wireless handsets and infrastructure and wireless LANs, M/A-COM Inc (Lowell, MA, USA) has installed at both its Colorado Springs fab and its newly acquired Roanoke operation (formally ITT GaAsTEK) a 25 GHz Enhancement/ Depletion (E/D) mode GaAs process.

This features two FET device types:

• one enhancement-mode FET (which supports on-chip gain mode switching without requiring a negative supply voltage) and

• one depletion-mode FET (for RF switching, mixing and amplification).

Larry Ward, General Manager Integrated Semiconductor Business Unit, says this gives cellphone transceivers half the current consumption (for equivalent RF performance) of the latest SiGe BiCMOS products (important for battery life and talk time). The process also supports integration of high-frequency analogue and high-speed digital circuitry on the same chip.

M/A-COM
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12-channel MSM photodetector array

Anadigics Inc (Warren, NJ, USA) has integrated a 1 x 12-channel Metal-Semiconductor-Metal photodetector array on a single GaAs substrate (operating at 850 nm with a polarity independent architecture) for use in both 2x Fibre Channel and Infiniband datacom networks capable of data rates up to 3.125 Gb/s per channel.

"Parallel optical communication systems are emerging for increased bandwidth applications," says President and CEO Dr Bami Bastani. Highly integrated photodetector receive arrays, coupled with optical-link laser transmit arrays, will provide the industry with scalable, space-efficient, broadband physical layer building blocks for high-density broadband fibre-optic parallel inter-connects for networking and fibre-optic backplanes, he adds.

Anadigics
Tel: +1-908-668-5000

Briefs...Briefs...

Equipment orders:

Trikon Technologies Inc (Newport, UK):

- from TriQuint Semiconductor Inc (Hillsboro, OR, USA) for additional Sigma PVD and MORI plasma etch cluster tools for its 6" GaAs line to meet growing demand for wireless devices.
- from a major North American communications company for eight plasma etch and PECVD systems for fabricating InP-based opto devices: MORI and ICP technologies on the Omega single-chamber platform for plasma etching InP and dielectric layers and Delta single- chamber plasma CVD systems depositing a range of dielectric materials.

Tegal (Petaluma, CA, USA): for another 6500 series plasma etch system (to ship early summer) from a "leading North American supplier of high-performance broadband networks" to process GaAs and InP.

Mattson Technology Inc (Fremont, CA, USA): TriQuint Semiconductor Inc has installed a multi-million dollar follow-on order for multiple Aspen II plasma-enhanced CVD systems at its newly expanded facility in Hillsboro, OR, USA.

Riber SA (Rueil Malmaison, France) has sold a MBE 49 (4 x 4") production system to the GaAs pure-play epiwafer foundry Global Communication micro-conductors Inc (Torrance, CA, USA).

MOCVD News

AIXTRON orders

AIXTRON has received orders for MOCVD Planetary reactors from:

- Marconi Caswell in Towcester, UK for an AIX 2600G3 (up to 5x6" - delivery early summer) for production of GaAs electronic and optoelectronic devices; and an AIX 2000 (7x2") for growth of InP-based laser devices.
- Mitsubishi Electric Corp (Itami, Japan) for an AIX 2400G3 (equipped with an automatic wafer handler with "silicon-industry-like" cassette-to-cassette operation) for laser production.

AIXTRON's 1999 results: revenues up 53% to Euro84.7m (Asia 39%; US 35%; Europe 26%), claiming a 53% share of the global market; net income up 92% to Euro10.4m; orders up 43% to Euro84.9m; order backlog at end -99 up 62% to Euro73.7m.

A new production facility started operation at the start of March, increasing capacity by more than 200 units per year, and a 49% rise in revenues to Euro126m is forecast for 2000.

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Epi-wafer News

IQE's sales up 20% in '99

Results for custom compound epi-wafer foundry IQE plc were:

Full-year '99:

- sales: up 20% on 1998 to a record £19.043m (despite almost the same production capacity over the year). This was due to improvements in yield, cycle time and throughput.
- orders: £24.5m (up from £16.5m in '98).

Q4/99:

- sales: a record £5.068m (up 9.5% on Q3/99 and 24.5% on Q4/98). This despite continued impact of testing and qualification, and revenue from the industry's first multi-wafer 6" MBE system only contributing towards the end of Q4/99 (investment in a VG Semicon V150 was only announced last September, but it is now qualified for initial production in Bethlehem by the top-three customers, with full production expected by year-end: "the risk associated with its operation has now been eliminated").
- Robotic handling for both 4" and 6" wafers on AIXTRON MOCVD systems in Cardiff was fully tested and is now in routine use: "qualification for HBTs for mobile phones is continuing".
- Capital expenditure, equipment leasing and deposits on new equipment were £5.941m (an acceleration of original plans).

Demand is expected to outpace capacity expansion throughout 2000, driven by:

- "increasingly sophisticated mobile communications", with the shift to 6" wafers for electronics (both HBT and PHEMT) accelerating;
- opto demand for telecoms increasing dramatically, especially due to strong growth in Internet infrastructure such as DWDM, fibre-optic systems for long-haul and metro networks, short-haul optical fibre links and mobile telephony systems.

Several component manufacturers are outsourcing for the first time. Installation of new-generation 4" reactors can supply traditionally fully captive manufacturers with a more cost-effective alternative than fully re-equipping their plants.

IQE has agreed:

(i) to run a customer's equipment from the Cardiff site, and

(ii) a further multi-year agreement with "a major telecom component manufacturer" to source 90% of their production;

together worth £3m over the next two years.

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Wafer News

AXT restates results: ships blue LEDs

American Xtal Technology Inc (Fremont, CA, USA) has announced Q4/99 revenues of US$21.8m and net income of US$1.6m.

However, certain expenses of Lyte Optronics before acquisition last May were understated by about US$4m, so restated fiscal '99 net revenues are US$81.5m and income US$3.5m (before acquisition costs of US$2.8m and the extraordinary loss of $500,000 from the acquisition of Lyte Optronics).

Also, in addition to its existing AlInGaP red, amber and yellow high-brightness LEDs, AXT has begun shipping AlInGaN blue (470 nm) HB-LEDs in pilot quantities.

• AXT is cooperating with Cal-OSHA in an investigation regarding higher-than-permissible levels of potentially hazardous materials in certain areas of its Fremont facility. AXT has now put in place engineering, administrative and personal protective equipment programmes.

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SiGe News

Conexant acquires Philsar

In January, Conexant Systems Inc (Newport Beach, CA, USA) acquired Microcosm Communications, which designs optical communications ICs including SiGe (joining its Network Access Division). Now, Conexant is acquiring Philsar Semiconductor Inc (Ottawa, ON, Canada), which is designing RF ICs such as BiCMOS SiGe fractional-N frequency synthesizers for W-CDMA 3G cellular handsets and single-chip, low-power Bluetooth radio (joining its Wireless Communications Division).

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Briefs...Briefs...

I.E.M. Technologies has launched the Gemini system, its first standard product for post-reactor abatement of toxic gases (e.g. arsine and phosphine) for compound semiconductors.

Longhill Industries Ltd (Hong Kong) has launched the model LH-860 Wafer Mounter to cater for the "trend to dicing thinner [silicon] wafers or more delicate GaAs wafers".

Motorola/IHP 0.35 µm SiGe:C BiCMOS

Nine months into joint work between Motorola's DigitalDNA Laboratories technology team and the Centre for Innovations for High Performance Microelectronics (IHP) in Frankfurt (Oder) Germany (formerly Institute for Semiconductor Physics), IHP's 0.35 µm silicon germanium carbon HBT technology has been integrated into the silicon RF BiCMOS process of Motorola Inc's Semiconductor Products Sector (with the addition of only one process step).

The use of a small amount of carbon with the germanium can improve integration of SiGe into the silicon CMOS process, according to Barry Johnson, chief technology officer and director of Motorola's Embedded Systems Technology Laboratories. The carbon can also help to reduce unwanted dislocations and mismatches between the microstructures of silicon and germanium, resulting in higher performance: $f_{max/T}$ is doubled (to 90/55 GHz), at half the current of traditional SiGe transistors (I_c < 10 µA @ $f_{max/T}$ =10 GHz), with better manufacturing latitude and a reduced noise figure. According to Behrooz Abdi, general manager of Motorola's RF/IF Division, the technology will allow multi-band, multi-mode RF ICs with integration of discrete and passive components previously deemed impractical.

Horacio Mendez, Motorola's director of RF/IF device development, adds "As wireless operating frequencies increase and we begin to integrate more of the passive components [including inductors], the industry will require a more aggressive analogue technology. SiGe:C technology not only allows a much simpler integration, but is easily portable to our next-generation high performance CMOS technologies."

First samples (a dual-band cellular low noise amplifier) will be available for external evaluation by August, with complete qualification end-2000 and production in early 2001. A 0.25 µm process has also been demonstrated at IHP's 200 mm wafer pilot line, with 0.18 µm targeted.

IHP
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Briefs...Briefs...

Freiberger Compound Materials (Freiberg, Saxony, Germany) has appointed ROM-Stuttgart as general contractor on a DM30m extension to its GaAs wafer production area, including construction of 2200 m^2 of cleanroom space.

Logitech says its new AWS1 abrasive wire saw, for up to 4" diameter by 4" long boules, can produce slices less than half the thickness produced by annular saws.

Groupe Arnaud is now sole European agent of Camelot Research and Development Inc, supplier of high-purity InP polycrystal for single InP crystal growth.

IDC reckons that, for Internet subscribers worldwide, mobile users (750m) may outnumber wired users (550m) by the end of 2002. By mid-2001, shipments of all digital handsets will be WAP capable.

Briefs...Briefs...

TriQuint Semiconductor Inc has released a four 3V RFIC set of CDMA receive chain ICs, for true tri-mode worldwide CDMA (IS-95 standard) operation: two LNAs and two downconvert mixers (each in cellular or PCS frequencies) for e.g. pagers, WLAN, or base station equipment.

Nitride News

Sumitomo's 2" GaN

Using the thermodynamic developments and expertise of Professor Seki and Assistant Professor Koukitu of the Tokyo University of Agriculture and Technology Faculty of Engineering, Sumitomo Electric Industries Ltd (Tokyo, Japan) has grown the first 2" single-crystal GaN substrate, large enough for practical use for blue lasers.

Compared to the current sapphire substrates:

- GaN is conductive, allowing electrodes to be placed on both sides of the chip (compared with two on one side for insulating sapphire), thus halving chip size and lowering costs.
- With substrate and epi layer of the same material, creation of a reflection plane for lasing by cleaving is easier.
- Fewer crystal defects (dislocations) in both the substrate and the epitaxial GaN increase laser lifetime.

SEI plans to begin sales by 2001, reckoning that the GaN single-crystal substrate will accelerate not only common use of blue (400 nm) lasers (e.g. for 25 GByte DVD instead of the current 4.7 GB with 650 nm red lasers) but also development of GaN electronic devices.

SEI
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Briefs...Briefs...

Intersil Corp (Palm Bay, FL, USA) is to use Amkor's 1 mm-thick MicroLeadFrame packaging for its PRISM II wireless LAN chip-set (which incorporates SiGe ICs). The package has half the size and parasitic lead inductance of 4.4 mm TSSOP packages and can therefore be used up to 8 GHz.

- Compaq Computer Corp has become the first computer company to ship PRISM II-based 11 Mbps (IEEE 802.11 standard) wireless LAN products - its WL Series for wireless PC networking. (Intersil is a founding sponsor of the Wireless Ethernet Compatibility Alliance).

STMicroelectronics Inc has renewed its volume purchase agreement with ASM International NV (Bilthoven, The Netherlands) for Epsilon 2000 reduced-pressure CVD epi reactors. An initial order of several reactors will be delivered to ST's fab in Carrollton, TX, USA for BiCMOS SiGe wireless telecom applications, with options for several times that during 2000 at ST sites elsewhere.

Further wide-bandgap substrate contracts for Cermet

Cermet has received further contracts from The Ballistic Missile Defense Organization (BMDO) under the Small Business Innovation Research (SBIR) programme to develop bulk wide-bandgap substrates:

- Phase 1 growth of bulk aluminum nitride of 1cm diameter (to be scaled for production of 2" wafers) for nitride power devices, detectors, and acoustic devices.
- Phase II production of 2" zinc oxide wafers (at a price competitive with sapphire) for nitride-based LEDs, lasers, transistors, UV detectors and UV light emitters based on nitrides and II-VIs (following Phase I last year);
- Phase II development of ZnO p-n junctions by MOCVD, to be demonstrated in UV laser diodes and LEDs (a US$1m contract).

Cermet has teamed with Hadis Morkoc at Virginia Commonwealth University to grow AlGaN/GaN heterostructures by MBE on ZnO (funded by the BMDO under the Small Business Technology Transfer programme). The programme will provide the technology basis for more effective nitride FET fabrication and thermal management, as well as more efficient device operation. Applications include advanced aviation and radar systems for the Department of Defense, automotive systems, and commercial aviation systems.

Cermet:
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Cree acquires Nitres...

Cree Inc (Durham, NC, USA) is acquiring Nitres Inc (Westlake Village, CA, USA) for about US$158.6m in stock. Nitres has developed nitride ultraviolet-to-blue LEDs (to 410 nm) with a quantum efficiency of 20% (claimed to be he highest reported to date) - complementing Cree's SiC-based devices and enabling development of commercial solid-state lighting sources. Also, both Cree and Nitres have been working on high-power nitride-based microwave devices. Nitres will become a wholly-owned subsidiary called Cree Lighting Co.

- Cree's fiscal Q3/2000 revenues were a record US$28.4m (up 19% on Q2/2000 and 77% on Q3/99); net income US$9.2m (up 171% on Q3/99). HB-LED shipments almost doubled sequentially (to over 80% of all Cree'sLED sales).

Company News

OBH acquires Plasma-Therm; becomes Unaxis

Oerlikon-Bührle Holding AG (Zurich, Switzerland) is nearing the end of its restructuring into a high-tech group with three strategic segments of IT, surface technology and components. After divesting Oerlikon-Bührle Immobilien, Bally and Oerlikon Contraves Defence, it is changing its name to Unaxis, and - before mid-2001 - will probably exercise its option to raise its stake in IC assembly equipment supplier ESEC from 26.9% to a controlling majority.

OBH has also acquired Plasma-Therm (St.Petersburg, USA) and will merge it with its BPS Semiconductors Division (which supplies UHV-CVD SiGe systems).

In the components segment, an Initial Public Offering of the instrumentation division is planned within the next 12 months.The vacuum pumps division will also be spun off and taken public.

OBH
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Briefs...Briefs...

Strategies Unlimited forecasts that, for DVDs, the market for blue lasers will overtake and eventually surpass current red laser technology by a factor of four in 2006.

Uniroyal Technology Corp (Sarasota, FL, USA) has hired Dr Jeffrey S Nelson from Sandia National Laboratories as Vice President and Chief Technology Officer of its High Brightness LED manufacturing division Uniroyal Optoelectronics in Tampa, Florida.
UTC has also announced a two-for-one stock split.

LumiLeds (San Jose, CA) was one of eight North American and European automotive suppliers named winners of an Automotive News' Sixth Annual PACE 2000 Award, with its SnapLED assembly technology for automotive lighting. Another was **Gentex Corp** (Rochester, NY) with "Binary Complimentary Synthetic White LED Illuminators: The New White Light".

The UK's Dr Richard Campion (**Nottingham University**) and Dr Trevor Martin (**DERA**) have started a joint two-year EPSRC/DERA scheme investigating growth of III-nitrides by MOCVD and PA-MOCVD, using a variety of gallium precursors combined with atomic nitrogen

Sumitomo commercialises ZnSe white LEDs

After developing ZnSe white LEDs in 1999 (from raw ZnSe to single-crystal substrate, epi thin film and final device), Sumitomo Electric Industries is installing manufacturing equipment at its Osaka Works. Mass production will begin this Autumn at 5m units a month, initially for backlighting colour and monochrome LCDs in mobile phones and (as performance improves) measuring instruments, indoor and outdoor display devices etc.

Currently, three or four LEDs of the same colour are used for backlighting cell-phone LCDs to avoid inhomogeneities in illumination. However, for colour LCDs, a white backlight is needed.

Features include:

1. Little deviation in chromaticity (by adding a small amount of dopant in the ZnSe substrate).
2. Low power consumption (low-resistance ZnSe substrate results in small forward voltage, allowing operation at less than 2.7 V and with two dry-cell batteries).
3. Small chip size (the conductive substrate allows electrodes top and bottom, reducing surface area - a chip in a size for conventional cell phones has already been developed).
4. Use of existing resources (the LED chip itself emits white light, so lamp manufacturers can use their own design and existing manufacturing processes - not possible with other white LEDs).

The LED produces white light by mixing blue light emitted from the ZnSe epi-layers with green - red light from the ZnSe substrate. The chromaticity is determined by the wavelength of the blue light and the intensity of the green to red emitted light. Since the fluctuation in wavelength of the blue light is small the deviation in chromaticity is limited. The green-red light from the substrate is the result of a phenomenon peculiar to ZnSe: the small amount of dopant in the ZnSe substrate causes absorption of short-wavelength light (blue light in the case of the ZnSe white LED element) and converts it (by photoluminescence) to longer-wavelength green-red light.

Opto News

Non-telecom laser market US$2.2bn by 2004

According to Strategies Unlimited (Mountain View, CA), the world market for non-telecom diode lasers is forecast to grow at a Compound Annual Growth Rate of 18.2% from US$966m in 1999 to US$2.228bn in 2004, driven by optical storage and pump lasers.

Of 25 application categories, optical storage and pump lasers dominate. Of seven market sectors:

• Continuing to dominate (though growing at just 15-20%) will be the mature Consumer sector (e.g. CD audio, CD-ROM-based video games, laser pointers) and Computer sector (via continued growth in PCs and peripherals, primarily optical storage such as DVD-ROM).

• The Diode-Pumped Solid-State Laser pump sector (with a CAGR of 32.0%) will be third largest by 2004, driven primarily by the continuing penetration into the conventional lamp-pumped laser market (particularly the emergence of kilowatt-class DPSSLs for industrial applications).

• The Automotive sector, though the smallest, will show the greatest CAGR of 50.1%.

• With CAGRs of 21%, the Industrial sector will be driven by emerging applications such as computer-to-press technology and the Medical sector by emerging therapeutic technology and newly developed procedures such as hair removal.

Product categories:

• Low-power visible lasers (the highest CAGR of 37.1%), driven by DVD players and DVD-ROM/RAM drives, and high-density blue-laser DVD.

• High-power infrared lasers (29.0%), driven by DPSSL pumping.

• Low-power infrared lasers (the largest product area in 1999) will decline due to the displacement of CD-ROM drives in PCs by DVD-ROM.

• Medium-power infrared lasers (19.3%), largely for the printing industry in computer-to-plate applications.

• Medium-power visible lasers will remain small due to the lack of any large-scale drivers.

Strategies Unlimited
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Briefs...Briefs...

According to "OPTOELECTRONICS - A Strategic Study of the Worldwide Semiconductor Optoelectronic Component Industry to 2003" from **Reed Electronics Research** (Tel: +44-20-8652-3120), the opto market was worth US$5.25bn in 1998 and will double in value by 2003 (a CAGR of 14.5%), led by image sensors, diode lasers and LEDs.

SOI News

Ibis' US$6m order

SIMOX-SOI wafer and implant equipment maker Ibis Technology Corp (Danvers, MA, USA) has received US$6m in orders from its largest customer (a US IC maker) for an Ibis 1000 oxygen implanter plus capacity reservation which will allow the customer to use a purchase credit toward wafers or an additional implanter (either an Ibis 1000 or a next-generation Ibis 2000 200mm/300mm implanter, which should start shipping in 2002).

Ibis is also leasing about 25,000 ft^2 of space in an adjacent building for SIMOX-SOI equipment manufacturing and R&D, making space for 15 implanters in total. Existing equipment manufacturing and R&D space will be converted to a cleanroom for additional wafer manufacturing.

II-VI News

Largest IR sensor

Rockwell Science Center is claiming the world's largest infrared image sensor and the world's largest CMOS chip (4.2m CdHgTe pixels detecting 0.9-2.5 μm wavelength light, together with 13m transistors on a 4x4cm die). The process was developed by Conexant Systems as part of a two-year programme funded by a consortium of astronomical laboratories, led by the University of Hawaii.

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Briefs...Briefs...

SOITEC has reported 127.7% growth in SOI wafer sales for the first nine months of its financial year. Wafer volumes shipped have increased eight-fold in less than a year. Initial radiation-hard applications for SOI are now less than 1% of revenues. (Rose Associates forecasts an SOI market of US$8bn by 2008.)

• To increase manufacturing capacity, SOITEC has placed a multi-million dollar order with **EV Group** of Scharding, Austria (formerly Electronic Visions until March) for automated SOI wafer bonding tools (jointly developed by SOITEC and EVG since 1997 - installation this June).

New TECSTAR opto group for HB-LEDs

TECSTAR Inc (City of Inustry, CA, USA) - which claims the world's largest GaAs MOCVD foundry in a single building - has formed a new Optoelectronic Products Organization to meet demand for epi-wafers for High-Brightness LEDs and related devices.

While solar power will remain a core product focus, similarities between solar-cell and LED epi-wafer processing will allow fixed overhead costs to be spread. Ms Ellen Linder will be head of product development.

• TECSTAR's David M. Van Buren has resigned as CEO (after eight years) and a member of the Board of TECSTAR and its subsidiaries. He will remain involved in a non-executive capacity in the interim. A new CEO will be appointed in a few months.

• Following the participation of the US Solar Motions' Cascade Cruiser (which uses TECSTAR triple-junction cascade solar cells) in the 1999 Australian Solar Car Challenge auto race (see last issue), the team is planning to enter it in another solar car race between Chicago and Los Angeles in 2001, as well as the 2001 Australian Solar Car Challenge.

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Spectrolab contracts

Spectrolab Inc (Los Angeles, CA, USA) has received US government approval to provide solar cells, panel and arrays to European spacecraft manufacturers. It is targeting Daimler Chrysler's Dornier Satellitensystem GmbH, Alcatel Space Industries, Alenia Aerospazio, and Matra Marconi Systems with its 24.5% efficiency multi-junction GaAs solar cells (the space industry's first, delivered last year) and 27% cells (delivered so far for three flight programmes, the first launching in late Summer).

• Spectrolab's multi-junction solar cells are also providing power to the Imager for Magnetopause-to-Aurora Global Exploration observatory spacecraft (built by Lockheed Martin Missiles and Space under contract to Southwest Research Institute for NASA, and launched March 25) to study the response of the Earth's magnetosphere to changes in the solar wind.

Sandia's InGaAsN cells

Sandia National Laboratories are developing InGaAsN solar cells for communications satellites: InGaP/GaAs/InGaAsN (2% N with In)/Ge, grown on GaAs in an EMCORE MOCVD reactor at 500-800°C. Nitrogen can reduce bandgaps by almost a third, giving a potential efficiency of 40% from a multi-layer cell structure. Other applications include lasers for optical communications.

Photovoltaics industry roadmap

A "Report of the PV Industry Roadmap Workshop" - coordinated by the National Center for Photovoltaics at the National Renewable Energy Laboratory (Golden, CO, USA) for the US Department of Energy's Photovoltaics Program - outlines goals and strategies for industry and R&D partners through 2020. These include 25% annual growth (compared to 15-20% historically) to US$10bn a year and the creation of tens of thousands of jobs. The solar-cell industry sees PVs producing at least 15% of the additional electrical power needed in the US in 2020.

Most markets now are outside the US: "The fastest growing market segment is for applications that connect directly into the electricity grid in Europe and Japan", according to Allen Barnet, president of PV manufacturer AstroPower Inc (Newark, DE, USA) and a member of the NCPV Advisory Board and PV Roadmap Steering Committee. "The driver in Europe is concern for the environment. The will of the people has been translated into government policy. In Japan, the driver is concern for the environment and energy independence". However, he stresses that utility deregulation in the US will provide an opportunity to create demand.

See www.nrel.gov/ncpv/pdfs/27450.pdf, or e-mail pvsac@sandia.gov

• The National Center for Photovoltaics has beaten its own world record (by more than 1%) for polycrystalline thin-film solar-cell efficiency, setting a figure of 18.8% with a copper indium gallium diselenide ($CuInGaSe_2$, or "CIGS") cell. This is near to the 20% bench-mark for current commercial multi-crystalline silicon solar cells. The improvement is attributed to optimised ZnO window layers and an improved interface between the CIGS and the CdS buffer layer. Thin-film cells promise low cost because less semiconductor material is needed (in this case, deposited by PVD on molybdenum-coated soda-lime glass).